Abstract

A study was conducted that involved inspection of damage on the Mississippi Gulf Coast due to Hurricane Katrina. Observations were made of damage to buildings and infrastructure as well as materials used in their construction. These observations were documented photographically and catalogued.

Major storm characteristics were determined such as storm extent, wind speeds, and storm surge height. Associated tornadoes and other wind events were also addressed. Data was obtained from storm simulations, sensors, radar records and post Katrina engineering studies. Hurricane Katrina characteristics relative to other storms of record are compared.

A careful study was made of building codes, residential and commercial. Discussion is provided of building code evolvement and current status. Particular interest was paid to the referenced standards providing design criteria for wind and flood loads. Some comparisons were possible of actual Hurricane Katrina winds and surge levels with those in the current guidance.

Degree of damage depended on type of material, construction (light or engineered) and if a structure was subject to wind or a combination of storm surge and wind. The study of Hurricane Katrina characteristics revealed the need for a hurricane classification format with an expanded scale for storm surge level. That modification (MSU Saffir-Simpson Scale) is proposed as being more effective in communicating to the public and responders storm surge danger for any particular hurricane event.

Review of existing and proposed building codes and design guides for both wind and flooding indicates utilization of land use planning and proposed building codes could mitigate future storm events. This includes hurricanes along the Gulf Coast and storms inland. Implementation of building codes infers trained staff for review, inspection and acceptance of projects. These functions should be supervised by an engineering department.

Executive Summary

With the next hurricane season imminent there is significant concern about safety of residents and fabric of the Gulf Coast economy and infrastructure. The coast is subject to storm surge and winds, sustained and gusting, as well as random wind events such as tornadoes, downbursts and mesovortexes. Coastal and inland wind related damage to structures resulting from Hurricane Katrina varied from light to severe. However, damage from Katrina storm surge varied from superficial to total destruction.

Storms that form and strengthen in the Gulf of Mexico represent a threat to the region. The threat is significant to increasing shoreline development. Hurricane Katrina was a major hurricane having characteristics that made it particularly dangerous. An analysis was conducted that included simulation and study of sensors and recorded observations. Goals of the analysis were to quantify magnitudes of storm surge and wind and extent of areas affected. Application of results will be to improve land use planning and to understand applicability of proposed building codes.

Projected winds along the coast from Hurricane Katrina exceeded wind map contours in ASCE 7. Consequently, the adequacy of design wind speed contours along the coast should be reconsidered. Also, Mississippi is subjected to high winds from thunderstorms and tornados yearly. Statewide building code adoption and implementation with engineering certification and inspection may greatly mitigate such wind and storm damage.

The current Saffir-Simpson scale for hurricanes originating in the Atlantic Ocean was not effective in highlighting the storm surge magnitude experienced along the Mississippi and Louisiana Gulf Coast from Hurricane Katrina. As a result, a modification to the scale is recommended to clearly communicate to the public and responders potential storm surge magnitudes. Format of the MSU Saffir-Simpson scale is:

MSU Saffir-Simpson Scale for Atlantic hurricanes.

Category	Maximum sustained winds	Storm Surge (approximate)		
	mph	feet		
		a	b	c
1 (Minimal)	74-95		4-5	
2 (Moderate)	96-110		6-8	
3 (Extensive)	111-130		9-12	
4 (Extreme)	131-155		13-18	
5 (Catastrophic)	> 155		> 18	

The above is an abbreviated table to highlight addition of the three levels of storm surge, a, b and c. Current work is underway to add definition to the storm surge levels.

In general, engineer designed structures of reinforced concrete, structural steel, and timber performed well during the storm surge. This suggests existing design criteria and construction practices for these types of structures either included storm surge loading or include adequate capacity for this additional mode of loading. This issue has a degree of uncertainty.

US Highway 90 bridges spanning the Biloxi Back Bay and Bay St. Louis and several Casino parking garages with large horizontal surfaces were subject to transient uplift and side forces imposed by storm surge. In simply supported structures as these, the transients were of sufficient duration and magnitude to displace the simply supported components resulting in structural failure.

Reinforced concrete construction, formed-in-place or stay-in-place, exhibited reasonable performance when imposed loads are considered. However, most light-frame wood structures subjected to storm surge were destroyed and it appears failure initiated at fasteners. However, it is not known whether strengthened connections alone would decrease damage because the overall structural capacity of such structures when lateral storm surge load is considered is much less than that of typical engineered structures that survived.